

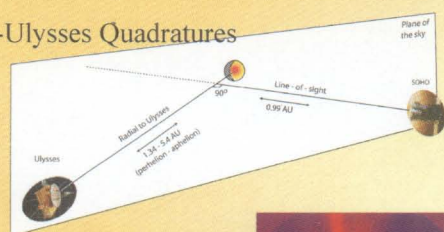
# SOHO-Ulysses Coordinated Studies During the Two Extended Quadratures and The Radial Alignment of 2007-2008

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## SOHO-Ulysses Quadratures

(1)



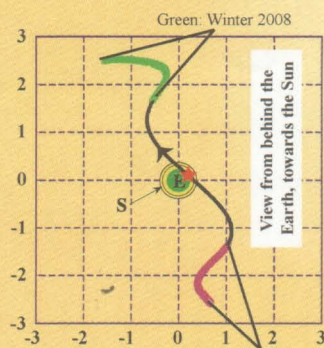
During quadrature, plasma seen on the limb of the Sun, along the radial direction to Ulysses, by SOHO or STEREO can be sampled *in situ* as it later passes Ulysses.

The figure shows a coronagraph image, the radial towards Ulysses at 58° S, and the SOHO/UVCS slit positions during one set of observations. A CME sub-sequently occurred and passed Ulysses (at 3.4 AU) 15 days later.



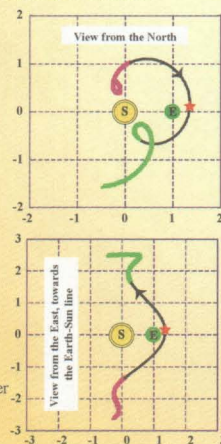
## Quadrature Geometry, winter 2007 and winter 2008

- ♦ Winter 2007. Ulysses will be **within  $\pm 5^\circ$  of the limb for ~ FIVE MONTHS**, from 19 December 2006 to 19 May 2007.
- ♦ Winter 2008. Ulysses will be **within  $\pm 10^\circ$  of the limb for ~ FIVE MONTHS**, from 2 December 2007 to 28 May 2008.
- ♦ The Sun will complete ~6 full rotations over each of these intervals.



Green: Winter 2008

Ulysses will be aligned with the Sun and Earth in summer 2007 - a "radial alignment". The **red star** marks the location of this alignment.

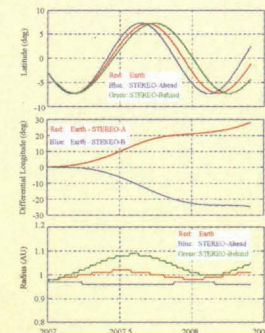
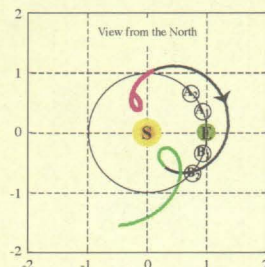


## (3) STEREO

STEREO A/B were launched in October 2006 and, soon after, begin moving away from Earth at  $\sim 22^\circ$  per year.

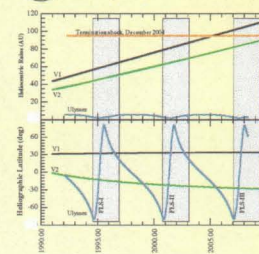
The figure at the right shows the locations of STEREO A/B approximately ONE and TWO years after launch. This will be towards the end of the two extraordinarily long quadrature intervals.

The winter 2008 quadrature will occur far enough into the next rise in the solar cycle that there will be a significant amount of high-latitude activity.



Relative positions of Earth/ACE/WIND/SOHO and STEREO A/B. The longitudes and latitudes are in heliographic coordinates. The plots run from 1 Jan 2007 through 30 May 2008. The Radius plots appear "jagged" because the radius value is only given to two significant figures after the decimal at the GSFC web site used for the orbits.

## (4) Voyagers 1/2

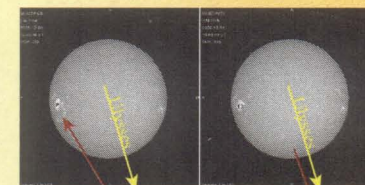
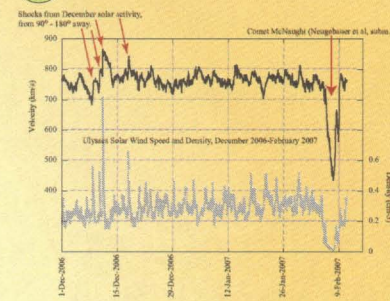


Voyager 1 passed the termination shock in December 2005. Voyager 2 is expected to do the same within the next few years. The latitude and radius of Ulysses and Voyagers 1/2 are shown here.

It takes roughly a year for solar wind that passes Ulysses to reach the termination shock. Therefore, wind passing Ulysses during the winter 2008 quadrature will enter the heliosheath in winter 2009, just about the time Voyager 2 will pass the shock. But, Ulysses will be in the opposite hemisphere.

By calibrating remote observations of the corona with STEREO A/B and SOHO, it will be possible to predict the character of the global solar wind throughout 2007-2010. This is the objective of the Whole Heliosphere Month and CIP #5 (Eberhard Moeblus, "State of the LISM at the Heliospheric Boundary and Inside").

## (5) Sample Result; Winter 2007



The 11 December shock was caused by a flare on 6 December, which caused a large Morton wave, had the largest microwave radio burst ever observed. Most SOHO instruments were shut off.

The active region produced additional flares on successive days, causing all of the shocks observed at Ulysses.

The most interesting thing about this activity is that Ulysses was immersed deep in fast wind coming from the southern polar coronal hole, with flow speeds of 700-800 km/s. The shocks had propagated into the fast wind, leaving the ejecta far behind. There was no trace of the ejecta at Ulysses.

At another time, these shocks could have been mistaken for microstreams driven by activity (e.g. white light jets) at the base of the coronal hole. However, with Ulysses being on the limb and the activity being on the disk meant that all of these events could be related to the observations at Ulysses. The possibility of jets within the coronal hole is entirely eliminated by the nearly continuous limb data available using a combination of SOHO/LASCO/EIT and MLSO.